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(54) Power amplifier system for an antenna system

(57) An antenna system (10) includes a splitter (34), which receives a splitter input signal (28) and produces a plurality of splitter output signals (36). A plurality of amplifiers (46) receive respective ones of the splitter output signals and produce respective amplified outputs. A combiner (56) transforms a plurality of the amplified outputs to an antenna signal. An antenna (22) receives and transmits the antenna signal. A power of the antenna signal is a function of a number of the amplified outputs communicating with the combiner.

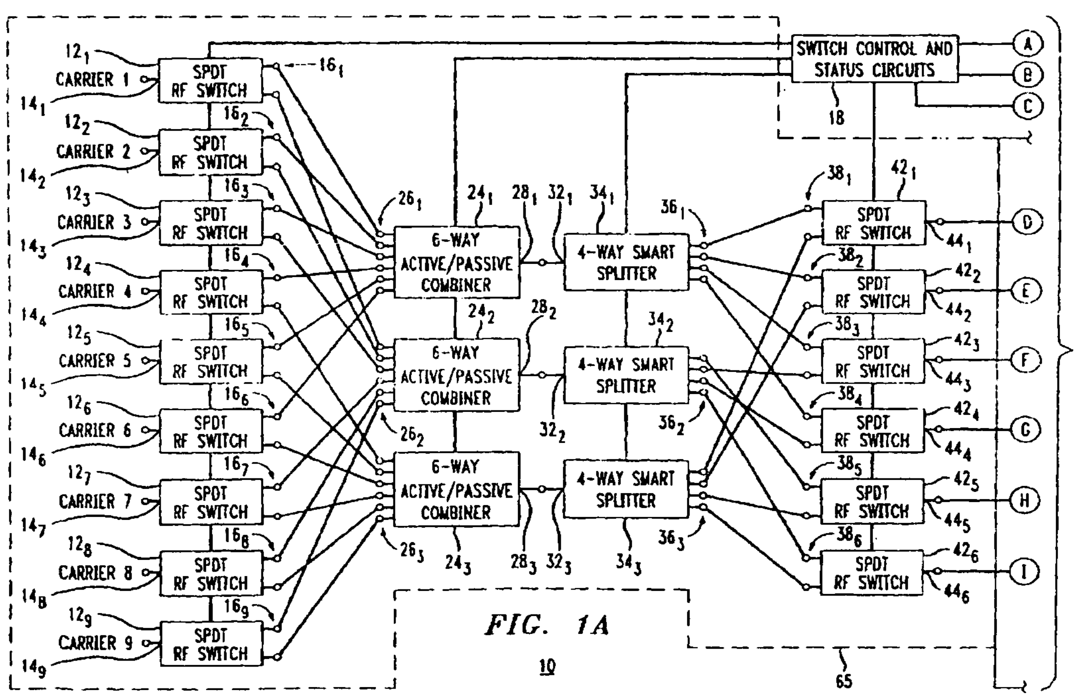

FIG. 1A

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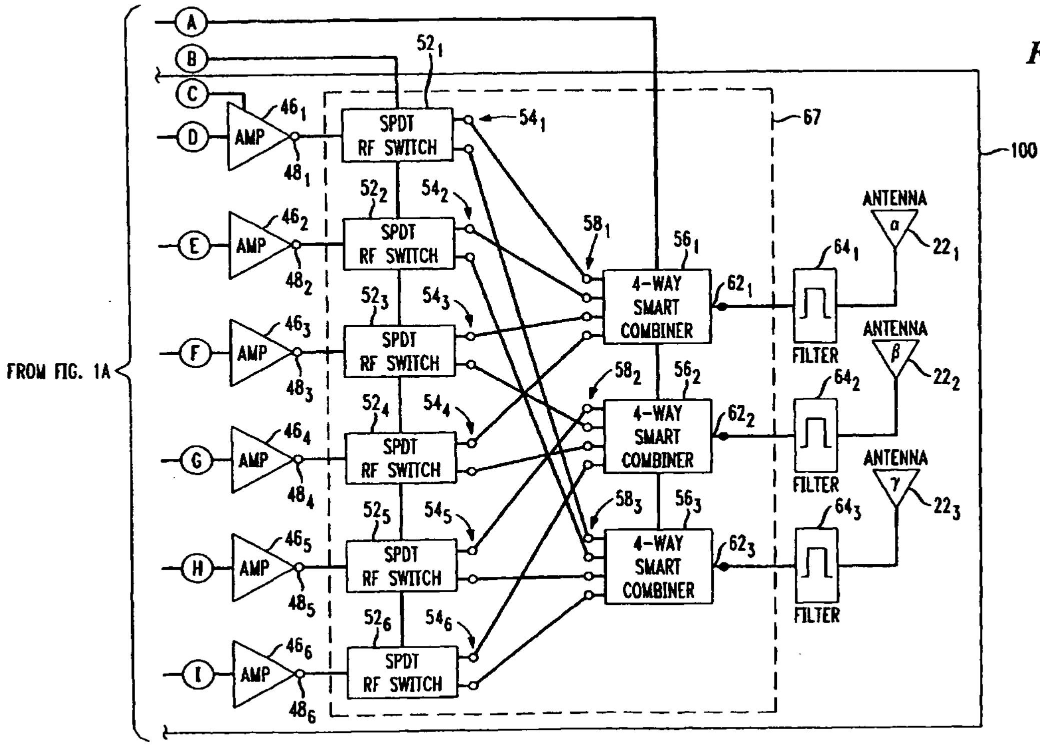
FIG. 1B


A
B
C
D
E
F
G
H
I
FROM FIG. 1A
AMP
SPDT RF SWITCH
4-WAY SMART COMBINER
FILTER
ANTENNA
α
β
γ
10
100
67

Description

Background Of The Invention

[0001] The present invention relates to power amplifier systems It finds particular application in conjunction with dynamic power amplifier systems, and will be described with particular reference thereto. It will be appreciated, however, that the invention is also amenable to other like applications.

[0002] When radio power is to be radiated (or received) by electronically scanning one (1) or more beams over a wide angular range with optimum efficiency, it is possible to use either passive or active antennas. Passive antennas include a main amplifier followed by a fixed or variable power divider together with phase shifters and/or switches. Active antennas incorporate radio-frequency amplifiers.

[0003] In conventional systems, antennas are positioned to radiate in corresponding directions. For example, three (3) antennas may be positioned to broadcast in three (3) respective sectors of a 360 degree angular range (i.e., each sector includes 120 degrees). Respective sets of amplifiers are electrically connected to the antennas in each of the sectors. Each set of amplifiers increases the power of the respective source signals before the signals are transmitted from the antennas. The maximum amount of power incorporated into any one of the source signals is a function of the number of amplifiers in each of the respective sets.

[0004] As discussed above, each of the amplifiers in conventional systems only communicates with a specific antenna and cannot be selectively switched to another one of the antennas in the system. Therefore, the power provided by the amplifiers cannot be selectively allocated among the antennas.

[0005] Assuming each antenna in the system only communicates with one set of amplifiers, the power output from any one antenna is a function of the number of amplifiers in the set. In other words, it is not possible for an antenna to communicate with an amplifier in another set of amplifiers. Therefore, if one of the amplifiers fails, the power output of the antenna connected to the failed amplifier decreases accordingly.

[0006] One method of compensating for failed amplifier(s) is redundancy. Redundancy involves incorporating additional amplifier(s) into each set of amplifiers communicating with an antenna. The additional amplifier(s) are not used unless one (1) or more of the amplifiers within the set fails. More specifically, the additional amplifiers are kept in an "off" state unless one (1) or more of the primary amplifiers fails. In this sense, the additional amplifier(s) act as backups to the primary amplifiers. Therefore, if one (1) of the primary amplifiers within a set fails, the additional amplifier(s) are switched on in order to compensate for the failure.

[0007] While redundancy provides backup amplifiers in the event that one (1) or more amplifier fails, conventional implementations of redundancy also increase the total cost and weight of the antenna system. More specifically, redundancy typically increases the total number of amplifiers in the antenna system. The increased cost and weight are undesirable. A need exists to provide redundancy without increasing the total number of amplifiers in an antenna system.

[0008] The present invention provides a new and improved apparatus and method which overcomes the above-referenced problems and others.

Summary Of The Invention

[0009] A power amplifier system includes a transmitting device and a plurality of amplifiers producing respective amplified outputs. First switching circuitry selectively switches a plurality of input signals to respective inputs of the amplifiers. Second switching circuitry selectively switches the respective amplified outputs to create a transmitting signal which is received and transmitted by the transmitting device. A power of the transmitting signal is a function of a number of the amplified outputs communicating with the transmitting device.

[0010] One advantage of the present invention is that redundant amplifiers are provided in an efficient manner.

[0011] Another advantage of the present invention is that respective powers of antennas in the system can be selectively set by a user.

[0012] Still further advantages of the present invention will become apparent to those of ordinary skill in the art upon reading and understanding the following detailed description of the preferred embodiments.

Brief Description Of The Drawings

[0013] The invention may take form in various components and arrangements of components, and in various steps and arrangements of steps. The drawings are only for purposes of illustrating a preferred embodiment and are not to be construed as limiting the invention.

FIGURE 1 illustrates an antenna system according to the present invention;

FIGURE 2 illustrates a flow-chart according to the system of the present invention;

FIGURES 3-6 illustrate respective antenna systems according to alternate embodiments of the present invention; and

FIGURE 7 illustrates a chart showing respective power outputs of antennas in systems having various numbers of amplifiers.

Detailed Description Of The Preferred Embodiments

[0014] With reference to FIGURE 1, an antenna system **10** includes nine (9) carrier switches **12**. Preferably, the carrier switches **12** are single-pole, double-through radio-frequency switches. However, other switches, capable of transmitting microwave or higher frequency signals, are also contemplated. Each of the carrier switches **12** includes a respective carrier input **14** and a set of two (2) carrier outputs **16**. Each carrier input **14** receives up to two (2) input channel (i.e., frequency) signals. In the preferred embodiment, the input signals are radio-frequency ("RF") signals. However, it is to be understood that microwave or higher frequency signals are also contemplated. The carrier switches **12** switch the RF signals received at the respective carrier inputs **14** to one (1) of the two (2) carrier outputs **16**.

[0015] A control circuit **18** electrically controls the carrier switches **12** by switching the respective input **14** to one (1) of the respective carrier outputs **16**. As will be discussed in more detail below, the settings of the carrier switches **12** are one of several factors in determining the powers of respective signals transmitted from three (3) respective antennas **22** in the system **10**. It is to be understood that the control circuit 18 is capable of being set by a user to selectively achieve the respective powers of the signals transmitted from the antennas **22**. In the preferred embodiment, each of the antennas **22** transmits a signal in one (1) of three (3) sectors of a 360 degree range (e.g., each antenna transmits a signal in a range covering 120 degrees). Therefore, it is possible to selectively control the powers of the signals transmitted in the respective sectors via the control circuit **18**. In this manner, the system **10** is considered to be a dynamic amplifier system.

[0016] Three (3) active/passive combiners **24** communicate with the carrier switches **12**. Each of the active/passive combiners **24** includes six (6) inputs **26**and one (1) output **28**, respectively. Each of the two (2) carrier outputs **16** for each of the respective carrier switches **12** communicates with a different one (1) of the active/passive combiners **24**. More specifically, as illustrated in FIGURE 1, one (1) of the carrier outputs **16_1** of the carrier switch **12_1** communicates with the active/passive combiner **24_1** while the other carrier output **16_1** communicates with the active/passive combiner **24_2**. The remaining connections between the carrier switches **12** and the active/passive combiners **24** are illustrated in FIGURE 1.

[0017] In the preferred embodiment shown in FIGURE 1, each of the active/passive combiners **24** receives six (6) RF signals from the various carrier switch outputs **16**. The active/passive combiners **24** combine the six (6) respective RF signals to form respective active/passive combiner output signals at the respective active/passive combiner outputs **28**. The signals are combined in the active/passive combiners **24** according to control signals received from the control circuit **18**. More specifically, the control circuit **18** may cause, for example, only three (3) of the six (6) input signals in one (1) of the active/passive combiners **24** to be combined to form the respective active/passive combiner output signal.

[0018] The active/passive combiner outputs **28** act as splitter input signals to respective inputs **32** of three (3) splitters **34**. In addition to the inputs **32**, each of the splitters **34** includes a respective set of four (4) outputs **36**. Although each splitter preferably includes a set of four (4) outputs, other embodiments, in which the splitters include more or less outputs, are also contemplated.

[0019] The splitters **34** divide (i.e., split) the respective input signals into a desired number of splitter output signals at the respective splitter outputs **36**. More specifically, the power of the splitter input signal is divided among the four (4) outputs **36** in each of the respective splitters **34**. Furthermore, the control circuit **18**, which determines respective loads on each of the splitter outputs 36, causes respective impedances of the splitter output signals to substantially match the load determined for the respective splitter output **36**. In this manner, the powers of the splitter output signals are transferred in an efficient manner. For this reason, the splitters **34** are referred to as "smart" splitters. Although the respective splitter input signals are divided among the four (4) outputs **36** in the preferred embodiment, it is to be understood that other embodiments, in which the splitter input signals are divided to fewer than the maximum number of splitter outputs, are also contemplated.

[0020] Each of the four (4) outputs **36** of the respective splitters **34** communicates with one (1) of a plurality of inputs 38 of respective input switches **42**. Furthermore, not more than one (1) of the splitter outputs 36 from a respective splitter **34** communicates with the same input switch **42**. In the preferred embodiment, the system **10** includes six (6) input switches **42**. Each of the input switches **42** includes two (2) inputs **38** and one (1) output **44**. Also, each of the input switches is a single-pole, double-through switch that transmits radio-frequency signals. However, other embodiments, in which the input switches include other numbers of inputs and/or transmit microwave or higher frequency signals are also contemplated.

[0021] The control circuit **18** controls the input switches **42** to transmit the respective input signals to respective amplifiers 46. More specifically, in the embodiment shown in FIGURE 1, one of each of the splitter outputs **36_1, 36_3** communicates with one of the input switch inputs **38_1**. Depending on the desired output powers of the antennas **22**, the control circuit **18** causes one of the inputs **38** for each of the input switches **42** to communicate with the respective amplifier **46** via the respective input switch output **44**. For example, the control circuit **18** causes one of the inputs **38_1** to communicate with the amplifier **46_1** via the input switch output **44_1**.

[0022] The control circuit **18** independently controls the power to each of the amplifiers **46**. In this manner,

if no signals are transmitted to the input switch 42_1 and, consequently, no signal is transferred to the amplifier **461**, the control circuit **18** may cause the power to the amplifier $\mathbf{46_1}$ to be shut off. Power to the other amplifiers **46** is controlled in a similar manner. Therefore, if certain amplifiers **46** are not necessary to achieve the desired powers of the respective output signals transmitted from the antennas **22,** those amplifiers **46** are preferably shut off.

[0023] During use, amplifiers consume DC power. Turning-off unused amplifiers increases both the DC and RF efficiencies of the system **10.** Furthermore, the fact that the power to the amplifiers may be selectively controlled allows for efficient redundancy in the system **10.** More specifically, because amplifiers are selectively switched to any antenna in the system, additional amplifiers are not necessary for each antenna. Therefore, if one amplifier fails, any other amplifier in the system may be used to boost the power of the signal output from any of the antennas.

[0024] A respective output **48** of each amplifier **46** communicates with a plurality of output switches **52.** Each output switch **52** includes a plurality of outputs **54.** In the preferred embodiment, each of the output switches **52** is a single-pole, double-through switch, which transmits radio-frequency signals, and includes a single input and two (2) outputs **54.** However, other embodiments, in which the output switches transmit microwave or higher frequency signals and/or include other numbers of outputs are also contemplated. The control circuit **18** causes each of the output switches **52** to transmit the signal from the respective input to one (1) of the respective outputs **54.**

[0025] Each of the outputs **54** for each respective output switch **52** communicates with a different one of a plurality of combiners 56. In the preferred embodiment, three (3) combiners **56,** each having four (4) inputs **58,** communicate with the output switch outputs **54.** Preferably, each of the outputs **54** for each respective output switch **52** communicates with a different combiner **56.** For example, one (1) of the outputs $\mathbf{54_1}$ for the output switch $\mathbf{52_1}$ communicates with the combiner $\mathbf{56_1}$ while the other of the outputs $\mathbf{54_1}$ communicates with the combiner $\mathbf{56_3}$.

[0026] The combiners 56 aggregate the signals received at the respective combiner inputs **58** and create respective antenna signals at combiner outputs **62.** The antenna signals are preferably passed through respective filters **64** before being transmitted from antennas **22.** The control circuit **18** causes the combiners **56** to aggregate the signals received at the combiner inputs **58** to have respective impedances that substantially match the antennas **22.** Therefore, the power of the signals is transmitted to the antennas **22** with maximum efficiency.

[0027] As has been described above, the power of the antenna signals is managed by the control circuit **18.** Preferably, a user sets the control circuit **18** to achieve a desired power output for each of the antenna signals. Then, the control circuit **18** activates the various connections and switches to direct certain input frequency signals from the carrier inputs **14,** through the various combiners **24, 56,** splitters **34,** amplifiers **46,** switches **42, 52,** and amplifiers **46** to achieve the desired result.

[0028] The control circuit **18,** which determines respective loads on each of the combiner outputs **62,** causes respective impedances of the combiner output signals to substantially match the load determined for the respective antennas **22.** In this manner, the powers of the combiner output signals are transferred in an efficient manner. For this reason, the combiners **56** are referred to as "smart" combiners.

[0029] In the embodiment shown in FIGURE 1, nine (9) RF carriers are combined, split, and ultimately fed into the three (3) antennas **22.** Each antenna **22** is capable of transmitting the combined signal of six (6) carriers. Because the smart combiners **56** include four (4) inputs **58,** each antenna **22** supports up to four (4) power amplifiers **46.** It is to be understood that the carrier switches **12,** the combiners **24,** the splitters **34,** and the input switches **42** comprise first switching circuitry **65** within the antenna system **10.** Furthermore, the output switches **52,** and the combiners **56** comprise second switching circuitry **67** within the antenna system **10.**

[0030] With reference to FIGURES 1 and 2, the carrier switches **12** are switched, in a step A, to output a respective carrier input signal to one of the active/passive combiners **24.** The respective combiner input signals are combined, via the active/passive combiners **24,** in a step B to form the respective splitter input signals. The respective splitter input signals are received into the splitters **34** in a step C. The splitter output signals are produced from the splitters **34** in a step D. Sets of the splitter output signals are received into the respective input switches **42** in a step E. The signals are switched to respective input switch outputs in a step F.

[0031] The signals are received into the amplifiers **46** and the respective amplified outputs are produced in a step G. The amplified outputs are switched to one of the respective output switch outputs in a step H. The output switch outputs are transformed, via at least two combiners, to respective the antenna signals in a step I. The respective antenna signals are received into the antennas **22** in a step J. The antenna signals are transmitted from the respective antennas **22** in a step K.

[0032] FIGURES 3-6 illustrate other embodiments of the present invention including various numbers of amplifiers and RF switches communicating with combiners, which include five (5) inputs and a single output. The embodiments shown in FIGURES 3-6 illustrate the concept that circuits such as those shown in FIGURE 1 can be easily expanded or contracted to include more/less amplifiers. It is to be understood that the circuits shown in FIGURES 3-6 are partial circuits corresponding to respective portions **100** of the circuit **10** shown in FIGURE 1. The respective numbers of components (e.g., input switches **42)** used for producing inputs to the circuits

shown in FIGURES 3-6 vary according to the respective number of amplifiers. Furthermore, it is to be understood that although respective control circuits are not illustrated in FIGURES 3-6, such circuits, like the control circuit **18** illustrated in FIGURE 1, are utilized to manage the respective circuits' operations in FIGURES 3-6.

[0033] FIGURE 3 shows a circuit **110** including three (3) amplifiers **112**. Three (3) output switches **114** are electrically connected to the respective amplifiers **112**. Each of the output switches **114** includes a single input and two (2) outputs **116**. Each of the outputs **116** for each respective output switch **114** is connected to a different one (1) of three (3) 5-way combiners **118**. Each of the 5-way combiners **118** includes five (5) inputs **122** and a single output **124**. The outputs **124** are connected to respective antennas **126** via filters **128**. As in the embodiment shown in FIGURE 1, the combiners **118** combine input signals to produce an output signal having an impedance substantially matched to a load on the respective output **124**.

[0034] Because there are three (3) output switches **114**, each having two (2) outputs **116**, each of the combiners **118** utilizes two (2) of the five (5) respective inputs **122**. Therefore, if each amplifier **112** outputs 20 watts, each of the antennas **126** outputs a signal in a range including zero (0) and 40 watts. However, it is to be understood that the total power output from all three (3) antennas does not exceed 60 watts (i.e., three (3) amplifiers each producing 20 watts).

[0035] FIGURE 4 shows a circuit **150** including six (6) amplifiers **152**. Six (6) output switches **154** are electrically connected to the respective amplifiers **152**. Each of the output switches **154** includes a single input and two (2) outputs **156**. Each of the outputs **156** for each respective output switch **154** is connected to a different one (1) of three (3) 5-way combiners **158**. Each of the 5-way combiners **158** includes five (5) inputs **162** and a single output **164**.

[0036] Because there are six (6) output switches **154**, each having two (2) outputs **156**, each of the combiners **158** utilizes four (4) of the five (5) respective inputs **162**. Therefore, if each amplifier **152** outputs 20 watts, each of the antennas **166** outputs a signal in a range including zero (0) and 80 watts. However, it is to be understood that the total power output from all three (3) antennas does not exceed 120 watts (i.e., six (6) amplifiers each producing 20 watts).

[0037] FIGURE 5 shows a circuit **200** including nine (9) amplifiers **202**. Six (6) output switches **204** are electrically connected to the respective amplifiers **202**. Each of the output switches **204** includes a single input and two (2) outputs **206**. Each of the outputs **206** for each respective output switch **204** is connected to a different one (1) of three (3) 5-way combiners **208**. Each of the 5-way combiners **208** includes five (5) inputs **212** and a single output **214**. Three (3) of the amplifiers are connected directly to the respective combiners **208**. In this manner, each of the five (5) inputs **212** for each of the combiners **208** is used. The outputs **214** are connected to respective antennas **216** via filters **218**. As in the embodiment shown in FIGURE 1, the combiners **208** combine input signals to produce an output signal having an impedance substantially matched to a load on the respective output **214**.

[0038] As discussed above, all five (5) of the respective inputs **212** are utilized for each of the combiners **208**. Therefore, if each amplifier **202** outputs 20 watts, each of the antennas **216** outputs a signal in a range including zero (0) and 100 watts. However, it is to be understood that the total power output from all three (3) antennas does not exceed 180 watts (i.e., nine (9) amplifiers each producing 20 watts).

[0039] FIGURE 6 shows a circuit **250** including twelve (12) amplifiers **252**. Six (6) output switches **254** are electrically connected to the respective amplifiers **252**. Each of the output switches **254** includes a single input and two (2) outputs **256**. Each of the outputs **256** for each respective output switch **254** is connected to a different one (1) of three (3) 5-way combiners **258**. Each of the 5-way combiners **258** includes five (5) inputs **262** and a single output **264**. Three (3) of the amplifiers are connected directly to the respective combiners **258**. In this manner, each of the five (5) inputs **262** for each of the combiners **258** is used. The outputs **264** are connected to respective antennas **266** via filters **268** As in the embodiment shown in FIGURE 1, the combiners **258** combine input signals to produce an output signal having an impedance substantially matched to a load on the respective output **264**.

[0040] As discussed above, all five (5) of the respective inputs **262** are utilized for each of the combiners **258**. Therefore, if each amplifier **252** outputs 20 watts, each of the antennas **266** outputs a signal in a range including zero (0) and 100 watts. However, it is to be understood that the total power output from all three (3) antennas does not exceed 240 watts (i.e., twelve (12) amplifiers each producing 20 watts).

[0041] FIGURE 7 illustrates possible power outputs from respective antennas in three (3) sectors (α, β, γ) when, as in FIGURES 3-6, a 5-way smart combiner is used. The maximum output power per amplifier is assumed to be 20 watts. As shown in FIGURE 7, a system including three (3) amplifiers has two (2) possible output schemes. More specifically, in the first scheme, each of the three (3) antennas communicates with one (1) amplifier and, therefore, outputs 20 watts. In the second scheme, the antenna transmitting in the a sector, for example, communicates with two (2) amplifiers and, therefore, outputs 40 watts; the antenna transmitting in the β sector, for example, communicates with one (1) amplifier and, therefore, outputs 20 watts; the antenna transmitting in the γ sector, for example, communicates with zero (0) amplifiers and, therefore, outputs zero (0) watts. The various schemes for systems including other number of amplifiers are shown in FIGURE 7.

[0042] The invention has been described with refer-

ence to the preferred embodiment. Obviously, modifications and alterations will occur to others upon reading and understanding the preceding detailed description. It is intended that the invention be construed as including all such modifications and alterations insofar as they come within the scope of the appended claims or the equivalents thereof.

Claims

1. A power amplifier system, including:

   a transmitting device;

   a plurality of amplifiers producing respective amplified outputs;

   first switching circuitry for selectively switching a plurality of input signals to respective inputs of the amplifiers; and

   second switching circuitry for selectively switching the respective amplified outputs to create a transmitting signal which is received and transmitted by the transmitting device, a power of the transmitting signal being a function of a number of the amplified outputs communicating with the transmitting device.

2. The power amplifier system as set forth in claim 1:

   wherein the first switching circuitry includes a splitter receiving a splitter input signal and producing a plurality of splitter output signals;

   wherein the second switching circuitry includes a combiner transforming a plurality of the amplified outputs to the transmitting signal; and

   wherein the transmitting device includes an antenna receiving and transmitting the transmitting signal, a power of the transmitting signal being a function of a number of the amplified outputs communicating with the combiner.

3. The power amplifier system as set forth in claim 2:

   wherein the first switching circuitry includes an input switch for selectively switching the splitter output signals to the amplifiers; and

   wherein the second switching circuitry includes an output switch for selectively switching the amplified outputs to the combiner.

4. The power amplifier system as set forth in claim 2, wherein each of the splitter output signals is adapted to communicate with a different one of the amplifiers.

5. The power amplifier system as set forth in claim 4, wherein the splitter produces four splitter output signals.

6. The power amplifier system as set forth in claim 5, wherein the combiner is adapted for transforming at least four amplified outputs to the transmitting signal.

7. The power amplifier system as set forth in claim 2 wherein:

   the first switching circuitry further includes:

      at least one additional splitter receiving respective additional splitter input signals and producing a respective pluralities of additional splitter output signals;

      a plurality of input switches each having a plurality of inputs and an output, each of the inputs for each of the respective input switches being capable of receiving one of the splitter output signals from a different one of the splitters, each of the outputs being capable of transmitting one of the splitter output signals to a different one of the amplifiers;

   the second switching circuitry further includes:

      at least one additional combiner transforming respective pluralities of the amplified outputs to respective additional transmitting signals;

      a plurality of output switches each having an input and a plurality of outputs, the respective inputs being capable of receiving a different one of the amplified outputs and the outputs being capable of transmitting the respective amplified output to a different one of the combiners; and

      the transmitting device includes at least one additional antenna receiving and transmitting the respective additional transmitting signals, respective powers of the additional transmitting signals being a function of a number of the amplified outputs communicating with the respective combiner.

8. The power amplifier system as set forth in claim 7, wherein the first switching circuitry further includes:

a plurality of active/passive combiners for combining a plurality of respective combiner input signals to form the respective splitter input signals; and

a plurality of carrier switches each having an input receiving a carrier input signal and a plurality of outputs, each of the outputs of each of the respective carrier switches communicating with a different one of the active/passive combiners.

9. The power amplifier system as set forth in claim 1, further including:
a control circuit for dynamically and selectively controlling the amplifiers, the first switching circuitry, and the second switching circuitry.

10. The power amplifier system as set forth in claim 9, wherein the control circuit regulates a power to the respective amplifiers.

11. A method for transmitting signals, including:

selectively switching a plurality of input signals to respective inputs of a plurality of amplifiers;

selectively switching respective amplified outputs of the amplifiers to create a transmitting signal which is received and transmitted by a transmitting device, a power of the transmitting signal being a function of a number of the amplified outputs communicating with the transmitting device; and

transmitting the transmitting signal from the transmitting device.

12. The method for transmitting signals as set forth in claim 11:

wherein the step of switching the input signals includes:

receiving a splitter input signal into a splitter;

producing a plurality of splitter output signals from the splitter;

receiving respective ones of the splitter output signals into the amplifiers; and

wherein the step of switching the amplified outputs includes:
transforming, via a combiner, the amplified outputs to the transmitting signal, a power of the transmitting signal being a function of a number of the amplified outputs communicating with the combiner.

13. The method for transmitting signals as set forth in claim 12, wherein the step of receiving the splitter output signals into the amplifiers includes:
receiving each of the respective splitter output signals into a different one of the amplifiers.

14. The method for transmitting signals as set forth in claim 13, wherein the step of transforming includes:
transforming at least four of the amplified outputs to the transmitting signal.

15. The method for transmitting signals as set forth in claim 12, wherein:

the step of switching the input signals further includes:

receiving at least one additional splitter input signal into at least one respective additional splitter;

producing respective pluralities of additional splitter output signals from the at least one additional splitter;

the step of switching the amplified outputs includes:

transforming, via the combiner and at least one additional combiner, a plurality of the amplified outputs to respective transmitting signals;

receiving the transmitting signals into the transmitting device and at least one additional transmitting device, respective powers of the transmitting signals being a function of a number of the amplified outputs communicating with the respective combiner.

16. The method for transmitting signals as set forth in claim 15, further including:

passing the splitter outputs through a plurality of input switches, each of the input switches having an output communicating with a respective one of the amplifiers;

switching the input switches to output a respective one of the splitter output signals;

outputting the amplified outputs to the combiners via a plurality of output switches, each of the output switches having an input communi-

cating with a respective one of the amplifiers and a plurality of outputs capable of communicating with a different one of the combiners; and

switching the output switches to output the respective amplified outputs to one of the combiners.

17. The method for transmitting signals as set forth in claim 15, further including:

combining a plurality of respective combiner input signals, via a plurality of active/passive combiners, to form the respective splitter input signals; and

switching a plurality of radio-frequency carrier switches to output the combiner input signals to the respective active/passive combiners.

18. An antenna system, comprising:

a splitter receiving a splitter input signal and producing a plurality of splitter output signals;

a plurality of amplifiers receiving respective ones of the splitter output signals and producing respective amplified outputs;

a combiner transforming a plurality of the amplified outputs to an antenna signal; and

an antenna receiving and transmitting the antenna signal, a power of the antenna signal being a function of a number of the amplified outputs communicating with the combiner.

19. The antenna system as set forth in claim 18, further including:

at least one additional splitter receiving respective additional splitter input signals and producing a respective pluralities of additional splitter output signals;

a plurality of input switches each having a plurality of inputs and an output, the inputs being capable of communicating with the splitter output signals, each of the outputs being capable of transmitting one of the splitter output signals to a different one of the amplifiers;

at least one additional combiner transforming respective pluralities of the amplified outputs to respective additional antenna signals; and

a plurality of output switches each having an input and a plurality of outputs, the respective inputs being capable of receiving a different one of the amplified outputs and the outputs being capable of transmitting the respective amplified output to a different one of the combiners.

20. The antenna system as set forth in claim 19, further including:

a control circuit electrically connected to the splitters, the amplifiers, the combiners, the input switches, and the output switches for controlling the number of the amplified outputs communicating with the combiner.

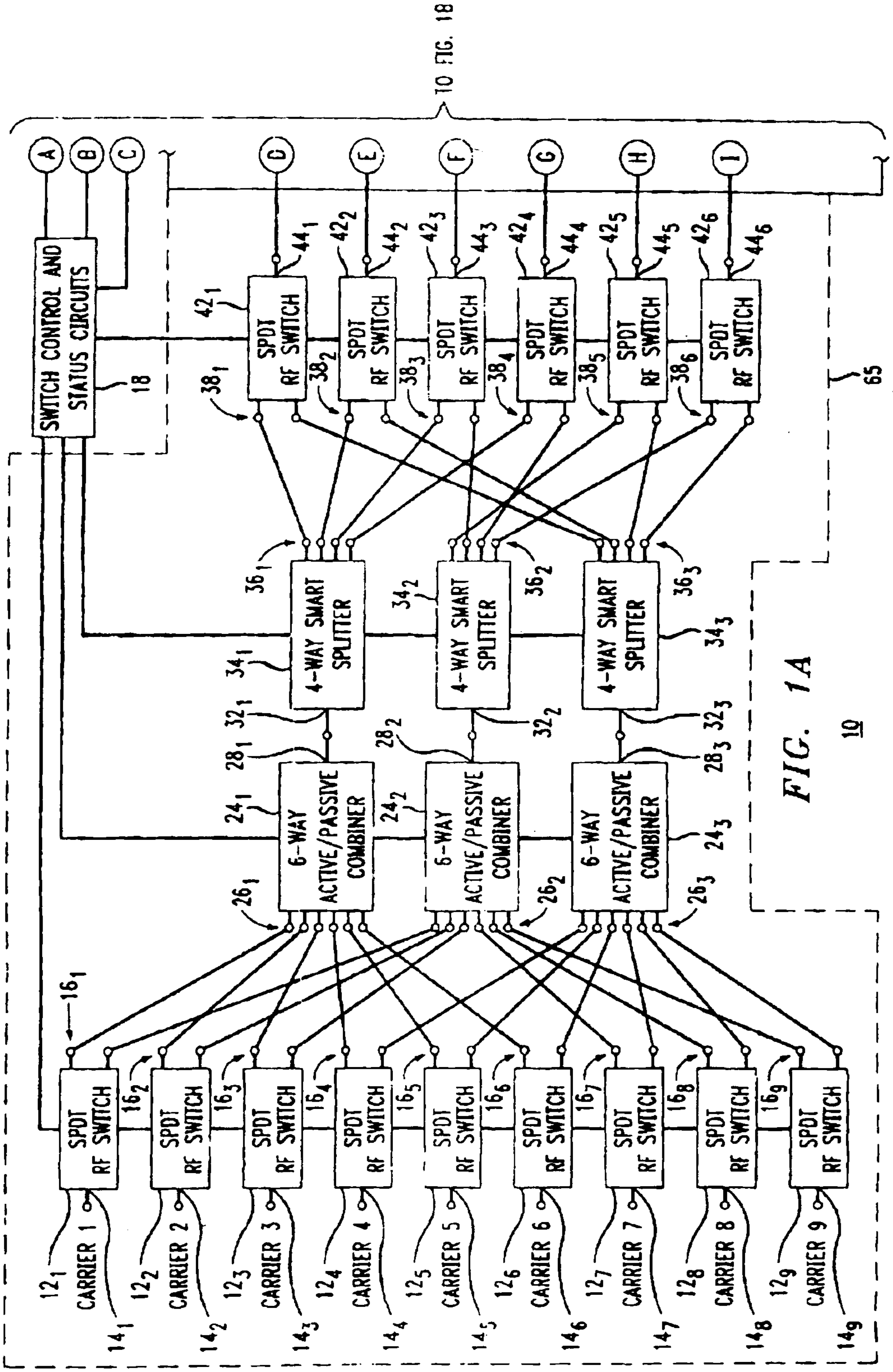
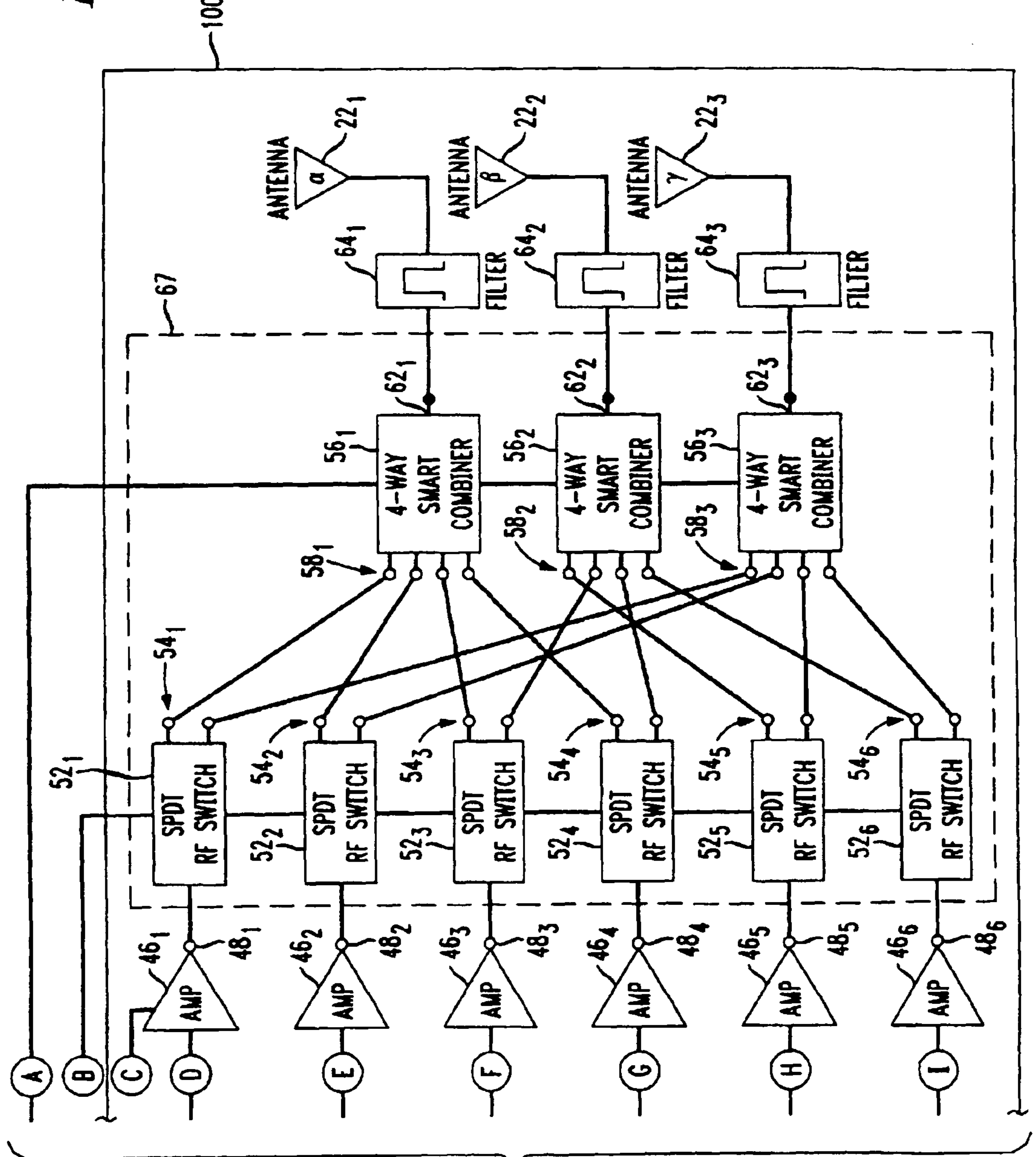

TO FIG. 1B
A
B
C
D
E
F
G
H
I
SWITCH CONTROL AND STATUS CIRCUITS
18
SPDT RF SWITCH
42_1 42_2 42_3 42_4 42_5 42_6
44_1 44_2 44_3 44_4 44_5 44_6
38_1 38_2 38_3 38_4 38_5 38_6
65
4-WAY SMART SPLITTER
34_1 34_2 34_3
36_1 36_2 36_3
32_1 32_2 32_3
28_1 28_2 28_3
6-WAY ACTIVE/PASSIVE COMBINER
24_1 24_2 24_3
26_1 26_2 26_3
16_1 16_2 16_3 16_4 16_5 16_6 16_7 16_8 16_9
CARRIER 1
CARRIER 2
CARRIER 3
CARRIER 4
CARRIER 5
CARRIER 6
CARRIER 7
CARRIER 8
CARRIER 9
12_1 12_2 12_3 12_4 12_5 12_6 12_7 12_8 12_9
14_1 14_2 14_3 14_4 14_5 14_6 14_7 14_8 14_9

FIG. 1A

10

FIG. 1B

10



FROM FIG. 1A

FIG. 2

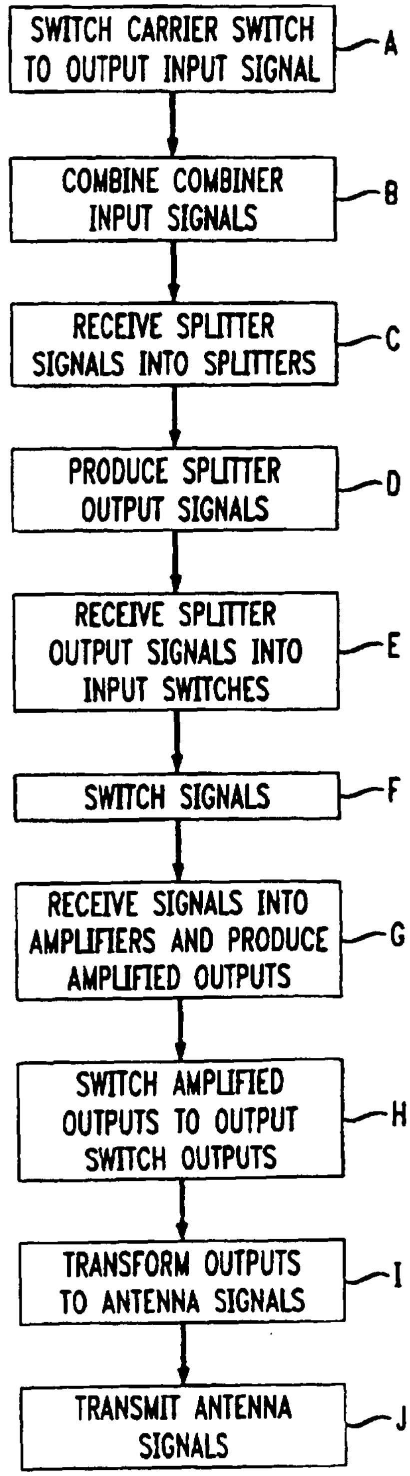

SWITCH CARRIER SWITCH TO OUTPUT INPUT SIGNAL
A
COMBINE COMBINER INPUT SIGNALS
B
RECEIVE SPLITTER SIGNALS INTO SPLITTERS
C
PRODUCE SPLITTER OUTPUT SIGNALS
D
RECEIVE SPLITTER OUTPUT SIGNALS INTO INPUT SWITCHES
E
SWITCH SIGNALS
F
RECEIVE SIGNALS INTO AMPLIFIERS AND PRODUCE AMPLIFIED OUTPUTS
G
SWITCH AMPLIFIED OUTPUTS TO OUTPUT SWITCH OUTPUTS
H
TRANSFORM OUTPUTS TO ANTENNA SIGNALS
I
TRANSMIT ANTENNA SIGNALS
J

FIG. 3

110

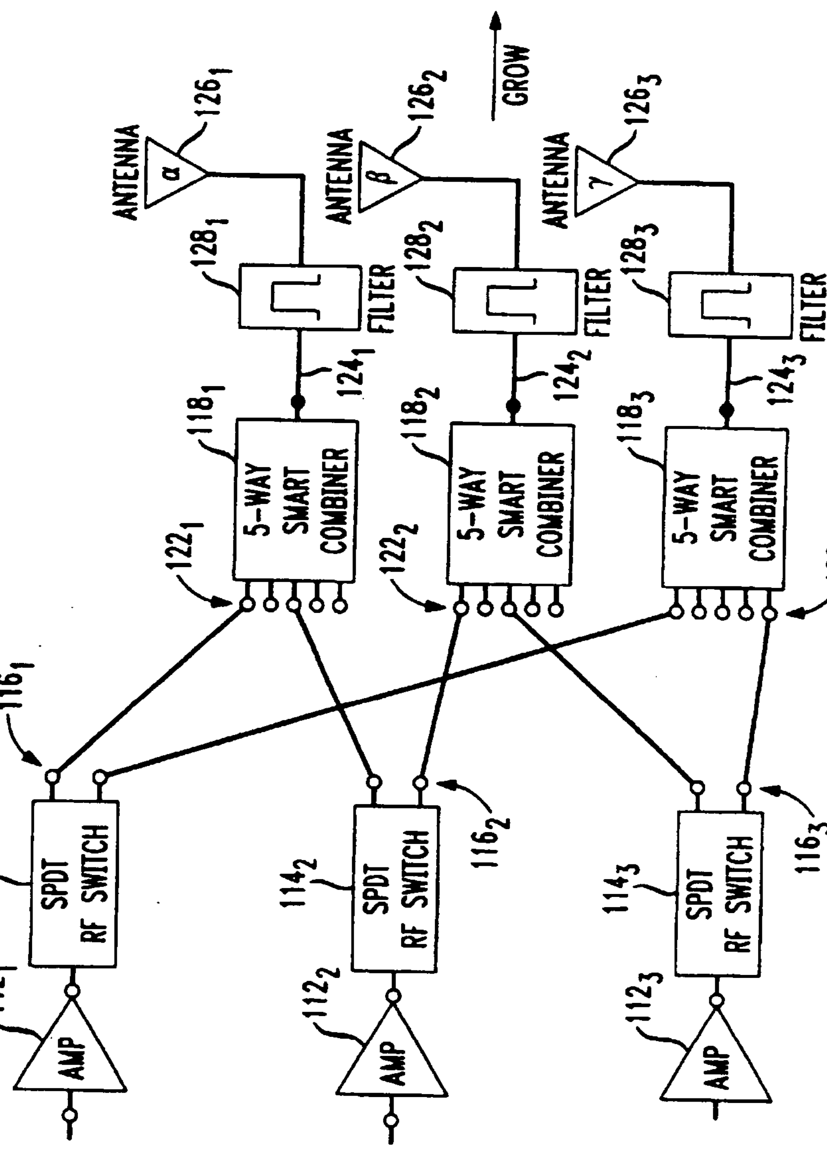

ANTENNA
α
126_1
ANTENNA
β
126_2
ANTENNA
γ
126_3
GROW
128_1
FILTER
128_2
FILTER
128_3
FILTER
124_1
124_2
124_3
118_1
5-WAY SMART COMBINER
118_2
5-WAY SMART COMBINER
118_3
5-WAY SMART COMBINER
122_1
122_2
122_3
116_1
116_2
116_3
114_1
SPDT RF SWITCH
114_2
SPDT RF SWITCH
114_3
SPDT RF SWITCH
112_1
AMP
112_2
AMP
112_3
AMP

FIG. 4

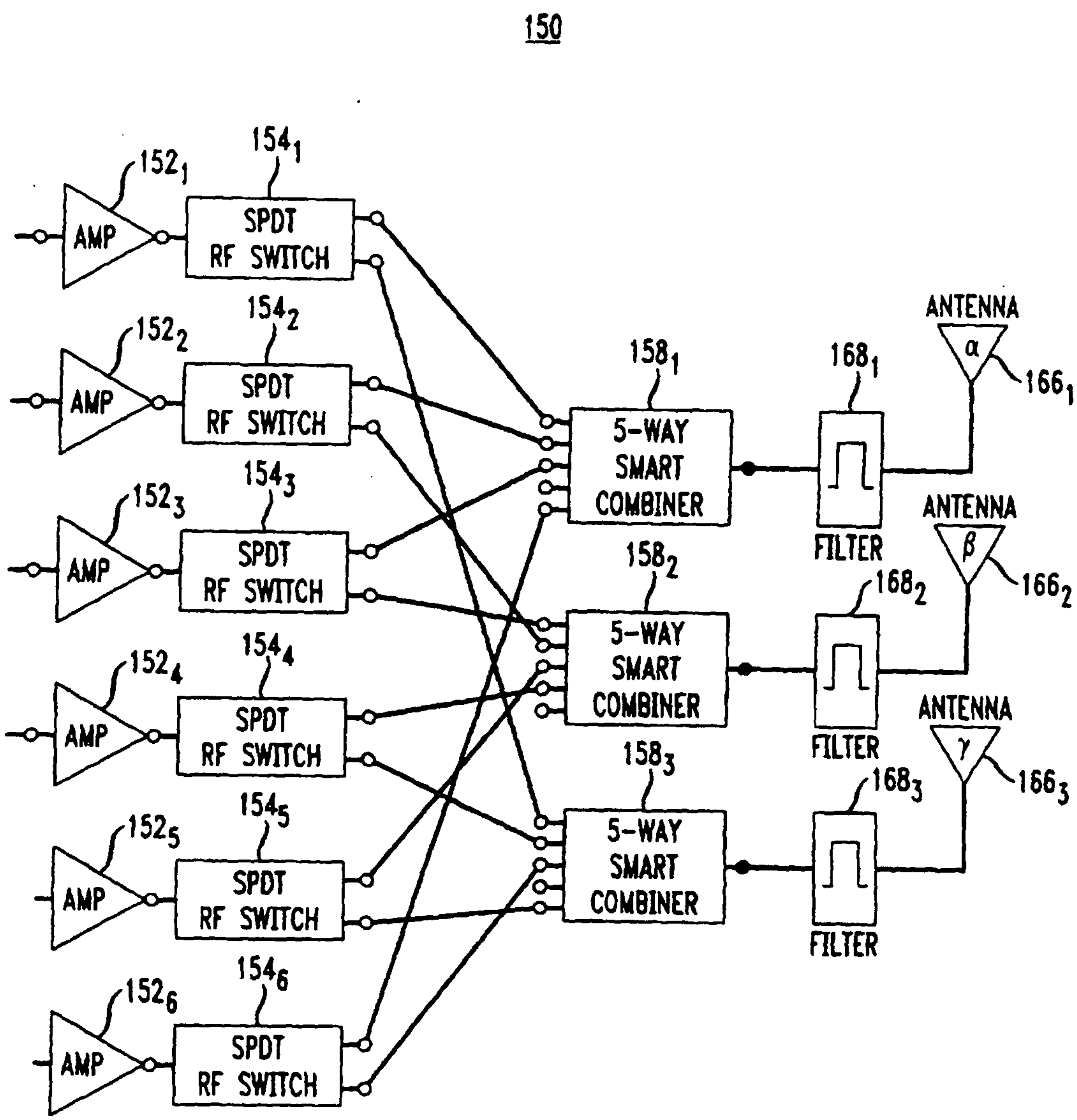

150
152_1
154_1
AMP
SPDT
RF SWITCH
152_2
154_2
AMP
SPDT
RF SWITCH
152_3
154_3
AMP
SPDT
RF SWITCH
152_4
154_4
AMP
SPDT
RF SWITCH
152_5
154_5
AMP
SPDT
RF SWITCH
152_6
154_6
AMP
SPDT
RF SWITCH
158_1
5-WAY
SMART
COMBINER
158_2
5-WAY
SMART
COMBINER
158_3
5-WAY
SMART
COMBINER
168_1
FILTER
168_2
FILTER
168_3
FILTER
ANTENNA
α
166_1
ANTENNA
β
166_2
ANTENNA
γ
166_3

FIG. 5

200

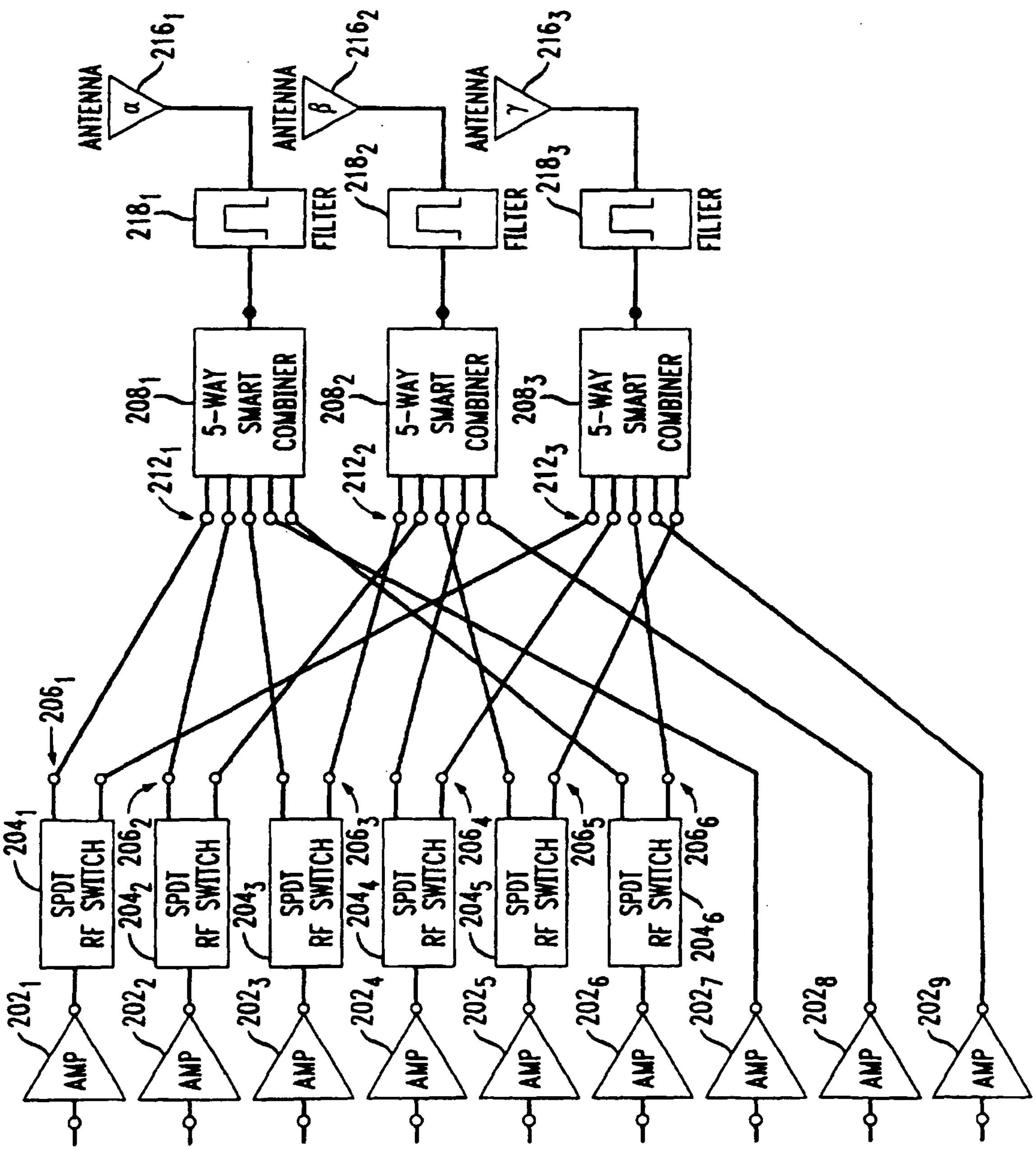

ANTENNA
α
216_1
ANTENNA
β
216_2
ANTENNA
γ
216_3
218_1
FILTER
218_2
FILTER
218_3
FILTER
208_1
5-WAY SMART COMBINER
208_2
5-WAY SMART COMBINER
208_3
5-WAY SMART COMBINER
212_1
212_2
212_3
206_1
206_2
206_3
206_4
206_5
206_6
204_1
204_2
204_3
204_4
204_5
204_6
SPDT RF SWITCH
202_1
202_2
202_3
202_4
202_5
202_6
202_7
202_8
202_9
AMP

FIG. 6

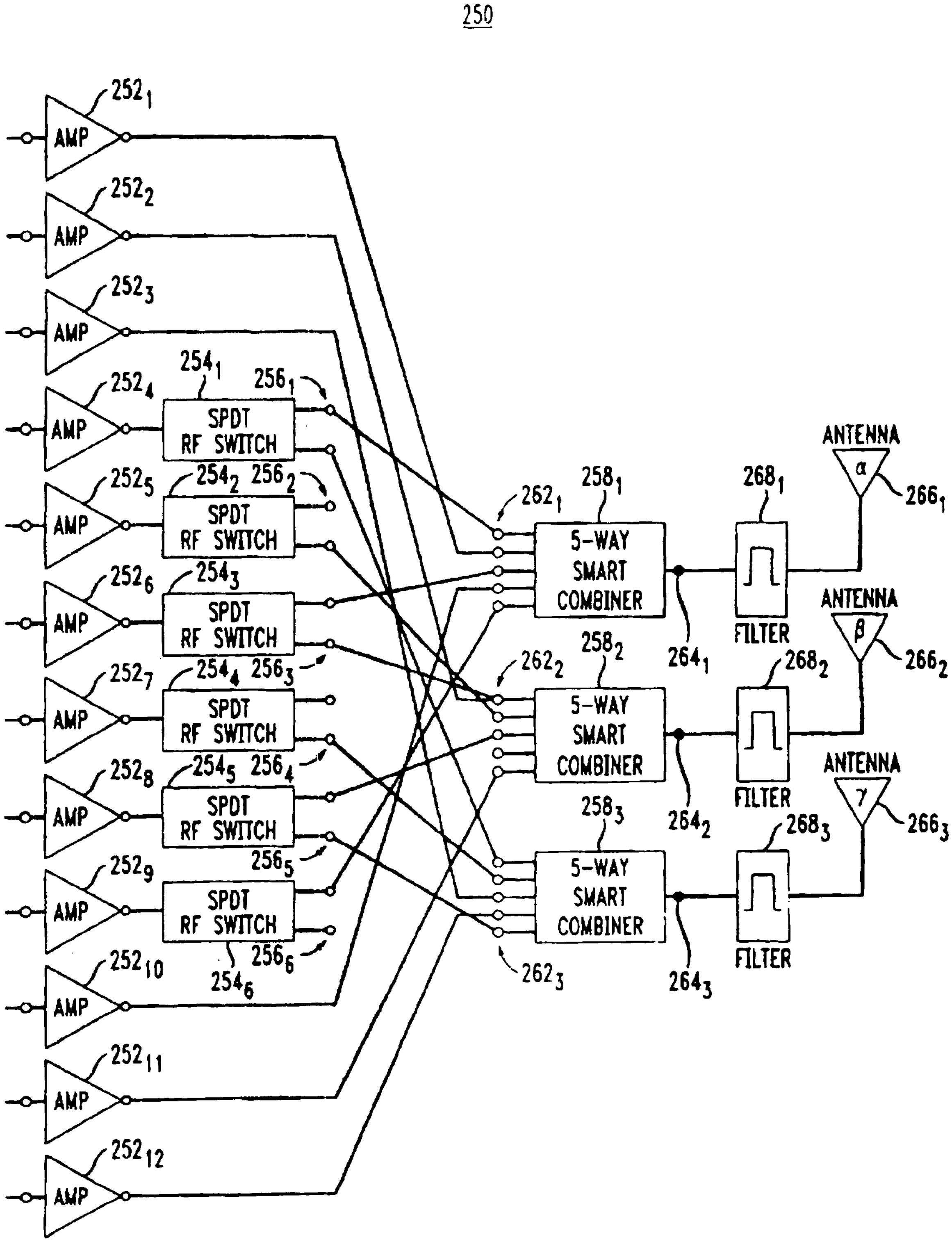

250
AMP
252₁
252₂
252₃
252₄
252₅
252₆
252₇
252₈
252₉
252₁₀
252₁₁
252₁₂
SPDT RF SWITCH
254₁
254₂
254₃
254₄
254₅
254₆
256₁
256₂
256₃
256₄
256₅
256₆
5-WAY SMART COMBINER
258₁
258₂
258₃
262₁
262₂
262₃
264₁
264₂
264₃
FILTER
268₁
268₂
268₃
ANTENNA
α
β
γ
266₁
266₂
266₃

FIG. 7

NO. OF AMPS	SECTOR	# AMPS	WATTS	# AMPS	WATTS	# AMPS	WATTS	# AMPS	WATTS	# AMPS	WATTS	# AMPS	WATTS
3	α	1	20	2	40								
	β	1	20	1	20								
	γ	1	20	0	0								
4	α	2	40	2	40	3	60						
	β	1	20	2	40	1	20						
	γ	1	20	0	0	0	0						
5	α	2	40	3	60	3	60	4	80				
	β	2	40	2	40	1	20	1	20				
	γ	1	20	0	0	1	20	0	0				
6	α	2	40	3	60	3	60	4	80	4	80		
	β	2	40	2	40	3	60	1	20	2	40		
	γ	2	40	1	20	0	0	1	20	0	0		
7	α	3	60	3	60	4	80	4	80	5	100	5	100
	β	2	40	3	60	2	40	3	60	1	20	2	40
	γ	2	40	1	20	1	20	0	0	1	20	0	0
8	α	3	60	4	80	4	80	4	80	5	100	5	100
	β	3	60	2	40	3	60	4	80	2	40	3	60
	γ	2	40	2	40	1	20	0	0	1	20	0	0
9	α	3	60	4	80	4	80	5	100	5	100	5	100
	β	3	60	3	60	4	80	4	80	3	60	2	40
	γ	3	60	2	40	1	20	0	0	1	20	2	40
10	α	4	80	4	80	5	100	5	100	5	100		
	β	3	60	4	80	3	60	4	80	5	100		
	γ	3	60	2	40	2	40	1	20	0	0		
11	α	4	80	5	100	5	100	5	100				
	β	4	80	3	60	4	80	5	100				
	γ	3	60	3	60	2	40	1	20				
12	α	4	80	5	100	5	100						
	β	4	80	4	80	5	100						
	γ	4	80	3	60	2	40						
13	α	4	80	5	100								
	β	4	80	4	80								
	γ	4	80	3	60								
14	α	5	100										
	β	5	100										
	γ	4	80										
15	α	5	100										
	β	5	100										
	γ	5	100										